

Promoting sustainable development issues through a creativity-centered e-learning course

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ABSTRACT

Purpose: One of the talents necessary for surviving in the modern economy is creativity which may be developed when students learn about global concerns through education for sustainable development which is recognised as having transformational power. The aim of this research is to propose an electronic course structure promoting sustainable development issues and developing students' creativity and to test its effectiveness.

Design/Methodology/Approach: During the formative pedagogical experiment (2021-2022) in the experimental group of 28 first-year television studies students, we modelled a creative seminar structure and used it to develop an electronic English language course in the Moodle Learning Management System. The control group included 27 1st year students of the same major who followed the curriculum-planned course. The results of the pre- and post-experimental questionnaire surveys were analyzed with the Mann Whitney U and ANOVA tests.

Findings: According to the results of the post-experimental diagnostics, the students of the experimental group demonstrated a more positive attitude towards the e-learning environment as one conducive to the development of their creativity than the students of the control group.

Conclusion: The positive shift in the experimental group students' attitude can indicate the effectiveness of the suggested electronic course structure. Thus, it is possible to conclude that using creativity as an organizing principle in an e-learning environment allows educators to introduce the most vital worldwide challenges to students as stimuli for creative tasks and in return, receive their creative solutions.

Keywords: *Creative process, Creativity, Electronic course design, ESD, LMS Moodle, Sustainable development.*

1. INTRODUCTION

Education for Sustainable Development (ESD) is a global educational strategy guided by the United Nations and the United Nations Educational, Scientific and Cultural Organisation (UNESCO). Starting with the 1992 United Nations Conference on Environment and Development which emphasized the impact education has on the shift towards sustainable development and following up with the Decade of Education for Sustainable Development (DESD) declared by the United Nations General Assembly from 2005 to 2014 with the purpose of facilitating integration of sustainability principles into the UN-member states' educational strategies and action plans (UNESCO, 2020), the ESD concept was later specified in the 2014 Aichi-Nagoya Declaration on Education for Sustainable Development and the Education 2030 Framework for Action (ESD 2030). Its history started with the 1992 United Nations Conference on Environment and Development where the impact of education on the shift towards sustainable development was particularly emphasized. Subsequently, the time period from 2005 to 2014 was declared the Decade of Education for Sustainable Development (DESD) by the United Nations General Assembly aiming at the integration of sustainability principles into the UN-member states' educational strategies and action plans

(UNESCO, 2020). The ESD concept was later specified in the 2014 Aichi-Nagoya Declaration on Education for Sustainable Development and the Education 2030 Framework for Action (ESD 2030).

ESD policies focus on enabling present and future generations to meet their needs by applying an integrated and balanced approach to the economic, social and environmental issues of sustainable development (UNESCO, 2014) as well as facilitating equal access to quality education (UNESCO, 2020). ESD promotes change in pedagogy, learning objectives and outcomes and the learning environment while focusing on the cognitive, behavioural and socioemotional aspects of learning (UNESCO, 2023).

According to research, the transformative power of ESD is in the development of students' critical thinking abilities and the empowerment of young people to take action by creating a new worldview and changing their attitude towards nature, raising awareness of its interdependence with humanity and fostering an understanding that the environment is more than just a resource for economic gain (Kazakova, 2021; Leiva-Brondo, Lajara-Camilleri, & Lull, 2022). Furthermore, this research highlights the crucial role of creative human capital and more especially, creativity in this process because the doctrine of sustainable development includes a continual expansion of creativity in the economy (Sipa, 2018).

Thus, the need for the development of creativity emerges from the realities of the contemporary economy and is represented in global educational and sustainable development strategies. In this regard, creative thinking as a pre-requisite should be viewed as a complex skill and should be formed across all school subjects in all learning environments by all teachers (Kampylis & Berki, 2014). Teachers can more effectively introduce sustainable development principles to students by encouraging the growth of their creativity. This will help teachers achieve their ultimate goal of empowering young people to effectively address the current economic, environmental and other challenges. Moreover, it is proven that teaching creative learning skills within specific subject areas is more effective than filtering them into a separate course (Mayer, 1989). Teachers should be encouraged to incorporate tasks aimed at developing students' creativity into their teaching practices.

The connection between ESD and creativity has been investigated in terms of its intersection with innovation (Sandri, 2013), mindfulness (Hensley, 2020) and applicability in mono and interdisciplinary learning (Braßler & Schultze, 2021).

However, we developed the following research questions due to the lack of specificity and useful recommendations for integrating the two in modern educational settings (e-learning environments in particular): How should an electronic course be organized to simultaneously raise students' awareness of sustainable development issues and develop their creativity?

Therefore, the objectives of this study are: 1) to propose an electronic course structure promoting the ESD agenda and developing students' creativity. 2) To test its effectiveness in a pedagogical experiment.

2. LITERATURE REVIEW

2.1. Creativity Research

Our review of the literature revealed that the classification of creative expressions known as the 4P is the one that researchers use most commonly in their study and teaching (Afolabi, Dionne, & Lewis, 2009; Doyle, 2018; Gruszka & Tang, 2017; Karakaya & Demirkan, 2015).

This classification was presented by Rhodes (1961) in his article titled "An analysis of creativity" as a systematization of multiple definitions of creativity. The author defines creativity as a phenomenon in which a person generates an innovative concept (product) resulting from a creative process influenced by one's surroundings (press) (ibid.).

This work's citation count is around 3.5 thousand. This paper which has received close to 3.5 thousand citations (Rhodes, 1961) demonstrates clearly how important it is to scholars studying creativity. It is most useful for doing one's own research on creativity since it provides an understandable theoretical foundation. It is most useful for doing one's own research on creativity since it provides an intelligible theoretical foundation (Puccio & Lohiser, 2020). Numerous well-known studies on creativity exist such as Simonton (1995) 5P creativity model (persuasion being the 5th P) which emphasises the need for creative people to be good leaders to promote their products or Runco's (2007) modification of the 4P model which organizes its components into a hierarchy and divides them into two groups (Runco, 2007).

Thus, creativity research is based on approaches that target the person, the process, the products, the environment or two or more of these variables (Alencar, Fleith, & Pereira, 2017). This suggests that the same

model of creativity may be used in many contexts with various outcomes since its components interact differently depending on the individual activity and thinking style and are represented in various ways (Hill & Johnson, 2003).

The cognitive approach to creativity is important in education. According to the 4P paradigm, creativity is mostly focused on the process and product elements such as developing a creative solution to a new challenge (Mayer, 1989). For educators, it means that the subject should be taught in a way that facilitates the application of the acquired knowledge to creative problem solving (ibid.; Wang (2009)). The following innovative solution is an outcome of creative behaviour.

According to Sloane, Endo, and Della-Piana (1980), a behavior or its product is likely to be creative if it is ruled by factors connected to stimulus control rather than the topography of the behavior itself. Other controlling variables are relationships between behavior products and the environment in which they are observed or produced (Mayer, 1989). Kim (2020) proved that in view of outcome expectations the social context becomes a substantial motivating factor. According to Amabile (2011) in the componential model of creativity, the social environment is the only component of creativity that contains extrinsic motivators or stimulants for intrinsic motivation and creativity (Amabile, 2011).

Therefore, the interaction between the creative product and the environment is bidirectional. On the one hand, it contains the stimuli to promote creative behavior. On the other hand, a creative product produces an emotional reaction both from the social environment and the creator.

In a nutshell, creativity is composed of cognition, behaviour and interaction with the socio-emotional environment (see Figure 1).

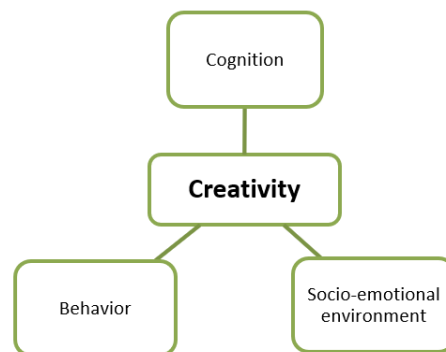


Figure 1. The structure of creativity.

This creative framework leads to the following interpretation of the creative process: 1) perceiving a problem or a creative behavior stimulus in the environment. 2) Devising a creative solution (product) for that problem. 3) Receiving socio-emotional feedback on the resulting creative product (see Figure 2). This cycle can be repeated as many times as needed.

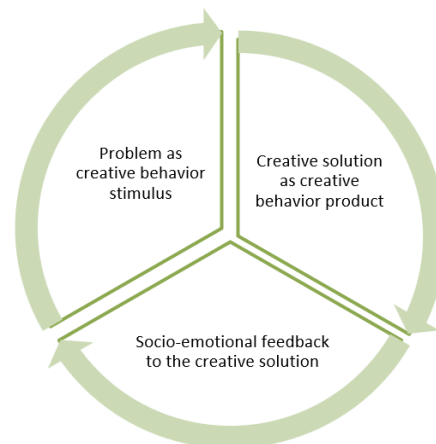


Figure 2. Creative process cycle.

The environmental factor is our primary focus in this study due to its position in the structure of creativity as the only externally controlled factor. It means that the effectiveness of the suggested electronic course structure in developing students' creativity will be measured by it. We consider it particularly relevant for e-learning in which the environment serves as both the exclusive source of creative stimuli and the organizer of students' activities.

2.2. Bringing Together Creativity Development and ESD in an Electronic Course

We applied the scheme of the creative process to the learning process which is based content-wise on education for sustainable development issues in the following way (see [Figure 2](#)).

Stage 1. Students are presented with a vital problem related to sustainable development.

Stage 2. Students learn about the existing ways to solve the problem and try to produce novel and creative methods of solving it.

Stage 3. Students present their creative works to the class, receive and give feedback to each other. If needed, Stage 3 can become a source of more specifically outlined creative stimuli for stage 1 of the creative process.

This method suggests the following activities from the teacher's point of view: Stage 1. Choosing a sustainable development issue as a stimulus for students' creative behavior. Such issues include climate change, poverty, hunger, health, quality education, gender equality, etc. The full list can be found in the Education 2030 Framework for Action ([UNESCO, 2015](#)).

Stage 2. Presenting the selected problem to the students in the learning environment.

Stage 3. Organizing the learning environment in order to receive the socio-emotional response of the class to the creative solutions.

It is beneficial to repeat the creative process (stages 1-3) with a specified creative stimulus if the undertaken activity and its product seem insufficient or incomplete.

It should be noted that if the creative activity is organized in an e-learning environment, some changes must be made in order to keep the creative process going smoothly. In our previous work ([Oskina, 2021](#)), we concluded that it is possible to develop students' creativity with the means of e-learning environment if the following pedagogical conditions are met: 1) organizing regular pedagogical communication between students and educators in the e-learning environment. 2) Designing an e-learning course in the logic of the creative process. 3) Providing novel learning content and activities through relevant educational materials and problem-based tasks from the subject area. 4) Informing students about digital tools that allow them to develop and place their creative products in the e-learning environment.

The pedagogical requirements 1 and 4 must specifically be satisfied for the creative process to be organised in the e-learning environment. If a teacher has knowledge of and is competent in using the instruments that enable synchronous and asynchronous involvement in this context, condition 1 can be satisfied. Condition 4 considers the characteristics of the e-learning environment and the need for the ultimate result created by students throughout their creative process take the form specific to this environment, namely text, audio, visual or audiovisual digital information. We suggest the teacher provide a list of free resources to create various kinds of digital content as supplemental material in order to make this easier for students.

Condition 2 can be observed by applying the [Tollingerova, Goloushova, and Kantorkova \(1994\)](#) hierarchy of learning tasks that starts with knowledge reproduction tasks and ends with the creative task itself (see [Table 1](#)). It must be noted that translating the creative process into various learning tasks is what distinguishes our model from prior research in the field.

Condition 3 is strongly related to the urgency and relevance of the creative stimulus which is achieved through presenting a sustainable development issue.

If we apply Moodle Learning Management System (LMS) to organize the creative process in the suggested way, the following activities can be used to provide regular pedagogical interaction between course participants: "Chat" for synchronous, "Open Forum" and "Seminar" for asynchronous communication (see [Table 1](#)).

Table 1. Stages of the creative process, the corresponding learning task hierarchy and suggested course resources and activities.

Stages of the creative process in the framework of ESD	Types of learning tasks	Course resources and activities (LMS Moodle)
1. Presenting a sustainable development issue as a stimulus for students' creative behavior	<p>1. Knowledge reproduction tasks (Tasks for recognition; tasks to reproduce data, concepts, definitions, and facts).</p> <p>2. Simple thinking operations (Fact-finding tasks; tasks to list and describe facts, processes and methods; tasks to compare and differentiate facts and ideas; tasks to define relations; tasks to abstract, specify and generalize, etc.).</p> <p>3. Complex thinking operations (Interpretation, transformation, induction, deduction, evaluation and argumentation tasks).</p> <p>4. Tasks to summarize knowledge (Composing a summary, review, etc.).</p>	Resources: "Label", "Page", "File". Activities: "Assignment".
2. Producing a creative solution as a creative behavior product	5. Tasks for productive thinking (Practical application of a theory, problem solving tasks, heuristic search tasks, etc.).	Resources: "Page", "Lightbox gallery", "Flash card set". "Hyperlink", "Folder", "File". Activities: "Glossary", "Interactive Content", "Lecture", "Page", "Assignment", "Seminar".
3. Receiving socio-emotional feedback on the creative solution	6. Group reflection tasks.	Activities: "Chat", "Open forum", "Seminar".

Stage 1. Presenting the task (problem) to be solved. Since the problem must appear as a stimulus for students to get involved in a creative process and then arrive at its solution, it must be presented in a way that engages their intrinsic motivation and interest. In the case of ESD, the teacher must clarify the background of the problem and be able to demonstrate a relationship between the global issue and its impact on students' lives as well as the benefits of its solution for individual students. The preparatory tasks for stage 2 (knowledge reproduction, simple thinking operations tasks, complex thinking tasks and tasks to summarize knowledge) are also included in this section.

Stage 2 is dedicated to the creative thinking task itself. It is beneficial to upload here supplementary materials and resources related to the problem in order to make the e-learning environment more stimulating.

Stage 3 is centered on receiving socio-emotional feedback on the creative solutions developed in stage 2. The purpose of this stage is to collectively determine if a devised solution is appropriate, novel or valuable. It also brings about reflection on the possible outcomes and implementation of students' creative responses.

The innovative seminar format for a sustainable development issue (education) that we organised on the LMS Moodle as a component of an English language course for students majoring in television studies is shown in Table 2. This study used a total of 4 such workshops.

Table 2. Creative seminar structure for an English language course in LMS Moodle promoting sustainable development issues in education .

Stages of the creative process in the framework of ESD	Learning tasks	Course resources and activities (LMS Moodle)
1. Presenting a sustainable development issue as a stimulus for students' creative behavior	<p>1. Tasks for knowledge reproduction. <i>Look through the flashcards and memorize the words.</i> The purpose of the assignment is to learn the relevant vocabulary. The assignment consists of reviewing flashcards with words and illustrations.</p> <p>2. Tasks involving simple thinking operations <i>Read the text and answer the questions.</i> This task is aimed at developing reading skills, activating the relevant vocabulary and presenting the selected sustainable development issue in a broader context.</p> <p>3. Tasks involving complex thinking operations <i>Look through the following resources on education problems.</i> The goal is to form associative connections related to the topic.</p> <p>4. Tasks to summarize knowledge (Composing a summary, reviewing, etc.). <i>Based on the resources below which education problem do you think is the most important now? Write a short essay.</i> The goal is to activate the lexical and grammatical content of the topic with the support of internet resources that present the problem in more detail.</p>	Course activity "Interactive Content" (H5P interactive content plugin); Course activities "Open forum", "Chat" for synchronous and asynchronous communication.
2. Producing a creative solution as a creative behavior product	<p>5. Tasks for productive thinking <i>Creative Seminar: Solving Education Problems.</i> The goal is to make a final creative product on the selected issue (Education). <i>Resources for creating and editing digital content</i> This section presents content creation tools that students can use free of charge.</p>	Course activities: "Interactive Content" (H5P Interactive Content plugin), "Assignment", "Seminar" Resources "Lightbox Gallery", "Hyperlink", "Page"
3. Receiving socio-emotional feedback on the creative solution	<p>6. Group reflection tasks. <i>How creative is this work on a scale of 1 to 5?</i> This peer-assessment task encourages students to reflect on the level of creativity of the submitted works. The cumulative grade can be counted as follows: 80% of the arithmetic average of classmates' grades and 20% of the grade for grading.</p>	Course activities: "Chat", "Open Forum", "Seminar".

We have diversified the types of tasks needed to support the creative process in order to include the activities for language learning, i.e. the vocabulary and reading tasks (see Table 2). We were still able to organize them in the logic of the creative process starting with the knowledge reproduction and simple thinking tasks and ending with the creative thinking activity.

Thus, the electronic course re-designed for our purposes structurally which consists of separate seminars organized in accordance with the stages of the creative process and their corresponding learning tasks (see [Tables 1 and 2](#)).

The effectiveness of the electronic course structure consist of distinct creative seminars as suggested in Table 2 will be evaluated by students' attitudes towards the online learning environment they use to complete their coursework because the socio-environmental component of creativity is the primary focus of this study.

3. RESEARCH METHODS

We used modeling, formative pedagogical experiment in the experimental group, pre- and post-experimental questionnaire surveys (Google Forms) and statistical analysis (Mann Whitney U test, ANOVA test) methods in our research.

We were able to develop an innovative seminar that promoted concerns about sustainable development by using the modelling approach. [Tables 1-2](#) will be applied in the formative educational experiment later. The formative pedagogical experiment (2021-2022) was conducted in the experimental group which consisted of 28 (27 at the post-experimental stage) 1st year St. Petersburg State University of Film and Television students majoring in Television Studies (average age: 18.5 years old). The English Language electronic course of the experimental group, placed in the LMS Moodle of the university was re-designed into a hierarchy of learning tasks as shown in [Tables 1-2](#). The control group included 27 (25 at the post-experimental stage) 1st year students (average age:18.5 years old) of the same major and did a curriculum-planned set of tasks.

During the experiment, only one factor was changed, i.e. the e-learning environment. We equalized the experimental and control groups by observing the following conditions in order to avoid the influence of subjective factors: both groups had the same professor teaching the same subject using the same learning content within the same time period.

The objective of the questionnaire surveys was to find out whether changing the e-learning environment in accordance with the creative hierarchy of learning tasks is conducive to the rise in the positive emotional response of the students towards the learning process organized in the e-learning environment. Thus, the survey was completed before and after the formative experiment by both groups which allowed us to see the dynamics of students' emotional response to the e-learning environment. It must be noted that the number of both experimental and control group students who took the post-experimental survey was reduced due to objective reasons (not every student was able to complete the course) from 28 to 27 students in the experimental group and from 27 to 25 in the control group.

The data from the pre- and post-experimental questionnaire surveys were analyzed with the International Business Machines Statistical Package for the Social Sciences (IBM SPSS Statistics) software using the Mann Whitney U test to investigate if the 2 groups were significantly different from each other and the ANOVA (analysis of variance) test for analyzing differences among group means in the sample to essentially understand if there was a statistically significant change caused by the formative experiment.

4. RESULTS AND DISCUSSION

We will focus on the responses to the question "Do you believe that the e-learning environment helps boost your creativity?" in this article rather than the general findings of the pre- and post-experimental surveys (see [Figure 3](#)). [Figure 3](#) shows that 11% more respondents in the control group chose the "difficult to answer" (DTA) option while in the experimental group the equivalent percentage was evenly distributed among the remaining answers.

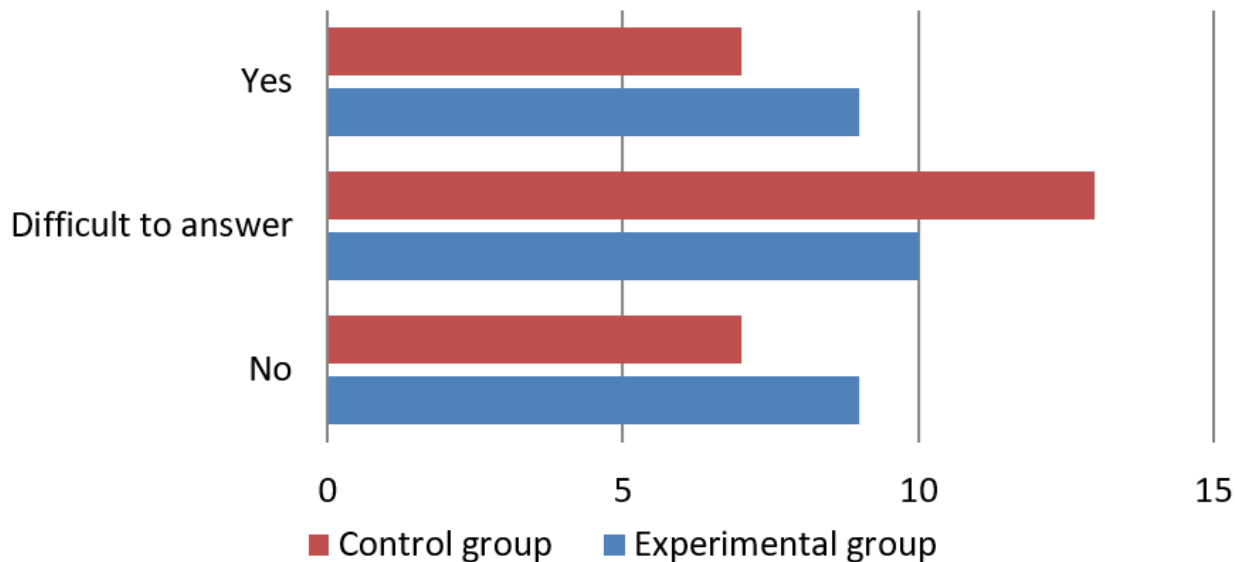


Figure 3. The pre-experimental distribution of students.

We conducted the Mann-Whitney U test in Tables 3–4 in order to verify that the two groups are equivalent.

Table 3. Pre-experimental Mann-Whitney test: Ranks.

Answer	Group	N	Mean rank	Sum of ranks
Yes	1	28	28.84	807.50
	2	27	27.13	732.50
	Total	55		
No	1	28	28.84	807.50
	2	27	27.13	732.50
	Total	55		
DTA	1	28	26.32	737.00
	2	27	29.74	803.00
	Total	55		

Table 4. Pre-experimental Mann-Whitney test: Statistics.

Test	Yes	No	DTA
Mann-Whitney U	354.500	354.500	331.000
Wilcoxon W	732.500	732.500	737.000
Z	-0.503	-0.503	-0.926
Asymp. sig. (2-tailed)	0.615	0.615	0.354

Note: Grouping variable: GROUP.

Table 5. Pre-experimental analysis of variance (ANOVA).

Answer		Sum of squares	df	Mean square	F	Sig.
YES	Between groups	0.053	1	0.053	0.249	0.620
	Within groups	11.292	53	0.213	-	-
	Total	11.345	54	-	-	-
NO	Between groups	0.053	1	0.053	0.249	0.620
	Within groups	11.292	53	0.213	-	-
	Total	11.345	54	-	-	-
DTA	Between groups	0.213	1	0.213	0.855	0.359
	Within groups	13.169	53	0.248	-	-
	Total	13.382	54	-	-	-

It is possible to infer that the two groups are equal and that the survey results may be used in the analysis of variance (see Table 5) since the asymptotic significance (2-tailed) p-value is larger than 0,05 for all three responses (yes, no, difficult to answer).

The output of the ANOVA test indicates that the p-value in each case is more than $\alpha = 0,05$, therefore, there is sufficient evidence to conclude that all the means are equal (see Table 5).

In the context of our study, it means that the experimental and control groups are equal and can further participate in the experiment.

The data from the post-experimental survey was distributed as shown below in Figure 4.

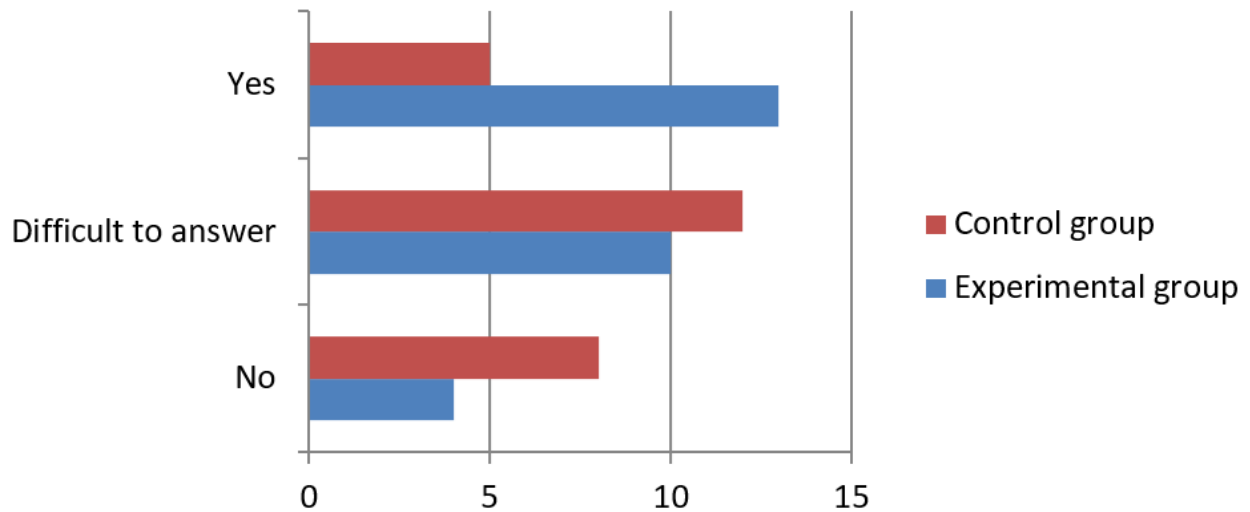


Figure 4. The post-experimental distribution of students.

There is a difference between the groups' post-experimental responses regarding their attitude towards the e-learning environment as the one conducive to creativity development (see figure 4). The positive responses were given 2.5 times more often in the experimental group than in the control group. This is consistent with the fact that students in the experimental group expressed their negative attitude twice as frequently as those in the control group.

We conducted the Mann-Whitney test to demonstrate that the formative educational experiment led to statistically significant improvements in the students' responses (see Tables 6-7).

According to the post-experimental output of the Mann-Whitney Test, the asymptotic significance (2-tailed) p-value is greater than 0,05 for two options (no, difficult to answer) but less than 0,05 for the yes option. It means that there have not been statistically significant changes caused by the experiment in the negatively and neutrally predisposed students in the experimental group whereas the number of students demonstrating a positive attitude towards the e-learning environment as a means of creativity development has indicated a change.

The output of the post-experimental analysis of variance (ANOVA) can be found in Table 8.

Table 6. Post-experimental Mann-Whitney test: Ranks.

Answer	Group	N	Mean rank	Sum of ranks
YES	1	27	30.02	810.50
	2	25	22.70	567.50
	Total	52	-	-
NO	1	27	24.35	657.50
	2	25	28.82	720.50
	Total	52	-	-
DTA	1	27	25.13	678.50
	2	25	27.98	699.50
	Total	52	-	-

Table 7. Post-experimental Mann-Whitney test: Statistics.

Test	Yes	No	DTA
Mann-Whitney U	242.500	279.500	300.500
Wilcoxon W	567.500	657.500	678.500
Z	-2.111	-1.455	-0.792
Asymp. sig. (2-tailed)	0.035	0.146	0.429

Note: Grouping variable: Group.

Table 8. Post-experimental analysis of variance (ANOVA).

Test	Yes	No	DTA
Mann-Whitney U	242.500	279.500	300.500
Wilcoxon W	567.500	657.500	678.500
Z	-2.111	-1.455	-0.792
Asymp. Sig. (2-tailed)	0.035	0.146	0.429

Note: Grouping variable: Group.

According to the results presented in Table, the p-value is greater than $\alpha = 0,05$ in the cases of no and difficult to answer variables, however, the yes variable demonstrated a p-value less than $\alpha = 0,05$ (0,033). Therefore, there is sufficient evidence to conclude that not all of the means are equal (i.e. yes variable) and this change is likely to have occurred due to a pedagogical experiment.

The change consists in the growth of positive emotional feedback from the experimental group when answering the question “Do you feel that the e-learning environment helps enhance your creativity?” It can be explained by the effectiveness of the suggested electronic course structure in developing students’ creativity and improving their attitude towards the e-learning environment because it succeeded in stimulating their intrinsic motivation as a creativity component. Another reason could be the novelty and urgency of the sustainable development issues that were used as stimuli for creative activity in the experimental group which might have contributed to motivating students to think creatively in order to find innovative solutions for them.

5. CONCLUSION

We developed an innovative seminar structure organised in an e-learning environment to promote sustainable development in this study. It encompasses separate creative seminars devoted to global problems. Each creative seminar consists of three stages: 1) presenting a sustainable development issue as a stimulus for students’ creative behavior. 2) Producing a creative solution as a creative behavior product. 3) Receiving socio-emotional feedback on the creative solution. Stage 1 includes tasks for knowledge reproduction, tasks involving simple thinking operations, tasks for complex thinking operations and tasks to summarize knowledge (composing a summary, review, etc.). Stage 2 requires completing the task to productive thinking. Stage 3 consists of group reflection tasks.

The results of our empirical study indicated the effectiveness of the suggested electronic course structure in developing students’ creativity and simultaneously raising their awareness of sustainable development problems. Therefore, a learning environment (in our case e-learning environment) using creativity as its organizing principle has proven to be an effective way of applying education for sustainable development principles since it naturally allows educators to introduce the most pressing global issues to the students as stimuli for creative tasks and in return receive their creative solutions.

The requirement for teachers to adapt their teachings in two ways may appear difficult. 1) Modify the learning content so that it includes sustainable development issues. 2) Use that content as a stimulus for creative tasks. Both could appear excessive for teachers who are obliged to prioritize packing a specific amount of learning content into each lesson over focusing on students’ personal development. However, our research demonstrates that due to the novelty and urgency of the creative stimuli and active learning prompted by the creative process, this twofold transformation may be a significant source of motivation for students to work on their regular assignments, especially those offered in e-learning.

The results of this study have mostly practical implications because we were able to demonstrate the effectiveness of the designed e-learning seminar structure in fostering student creativity and increasing their awareness of global sustainable development issues. Additionally, because the experimental group's emotional response to the

e-learning environment was positive after the experiment in which the structure was used, we can suggest it to other educators who are interested in involving students in e-learning. This study has certain limitations. The first one concerns the suggested course structure. Since it was applied only to the English language course, there is a probability that a different course will require some modifications. However, the nature of the creative process covered in the literature analysis section implies that the creative process should not significantly change in any field which allows us to anticipate content rather than structure-related modifications. The second one is determined by our choice of the LMS Moodle as a platform for the experiment. A changing platform might force the teacher to alter the resources and placement of different course elements as well as the tools used to enable synchronous and asynchronous communication among the student group. Therefore, additional research is required to shed light on these concerns.

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INSTITUTIONAL REVIEW BOARD STATEMENT

The Ethical Committee of the St. Petersburg Psychological Society, Russia has granted approval for this study on 16 June 2022 (Ref. No. 16).

TRANSPARENCY

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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REFERENCES

- Afolabi, M. O., Dionne, S., & Lewis, H. (2009). *Are we there yet? A review of creativity methodologies*. Retrieved from <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=8d766173f0298182291fda59cb1f0ee694015624>
- Alencar, E. M., Fleith, D. D. S., & Pereira, N. (2017). Creativity in higher education: Challenges and facilitating factors. *Temas em Psicologia*, 25(2), 553-561. <https://doi.org/10.9788/tp2017.2-09>
- Amabile, T. (2011). Componential theory of creativity. In (pp. 538-559). Boston, MA: Harvard Business School.
- Braßler, M., & Schultze, M. (2021). Students' innovation in education for sustainable development—a longitudinal study on interdisciplinary vs. Monodisciplinary learning. *Sustainability*, 13(3), 1-17. <https://doi.org/10.3390/su13031322>
- Doyle, C. L. (2018). Speaking of creativity: Frameworks, models, and meanings. *Creativity Under Duress in Education?: Resistive Theories, Practices, and Actions*, 3, 41-62. https://doi.org/10.1007/978-3-319-90272-2_3
- Gruszka, A., & Tang, M. (2017). The 4P's creativity model and its application in different fields. In Lisa Min Tang, Christian H. Werner (Eds), *Handbook of the Management of Creativity and Innovation: Theory and Practice*. In (pp. 51-71). New Jersey: World Scientific.
- Hensley, N. (2020). Educating for sustainable development: Cultivating creativity through mindfulness. *Journal of Cleaner Production*, 243, 118542. <https://doi.org/10.1016/j.jclepro.2019.118542>
- Hill, R., & Johnson, L. W. (2003). When creativity is a must: Professional 'applied creative' services. *Creativity and Innovation Management*, 12(4), 221-229. <https://doi.org/10.1111/j.0963-1690.2003.00285.x>
- Kampylis, P., & Berki, E. (2014). *Nurturing creative thinking international academy of education (IAE)*. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000227680>
- Karakaya, A. F., & Demirkan, H. (2015). Collaborative digital environments to enhance the creativity of designers. *Computers in Human Behavior*, 42, 176-186. <https://doi.org/10.1016/j.chb.2014.03.029>

- Kazakova, O. (2021). Education for sustainable development in English language classes. *Language Culture Education*, 6, 57-61.
- Kim, S. S. (2020). Exploitation of shared knowledge and creative behavior: The role of social context. *Journal of Knowledge Management*, 24(2), 279-300. <https://doi.org/10.1108/jkm-10-2018-0611>
- Leiva-Brondo, M., Lajara-Camilleri, N., & Lull, C. (2022). *Sustainable development goals awareness is improved after introduction of related activities in higher education degree subjects*. Paper presented at the In ICERI2022 Proceedings IATED.
- Mayer, R. E. (1989). Cognitive views of creativity: Creative teaching for creative learning. *Contemporary Educational Psychology*, 14(3), 203-211. [https://doi.org/10.1016/0361-476x\(89\)90010-6](https://doi.org/10.1016/0361-476x(89)90010-6)
- Oskina, A. (2021). *A model for developing students' creativity with the means of e-learning*. Paper presented at the In INTED2021 Proceedings IATED.
- Puccio, G. J., & Lohiser, A. (2020). The case for creativity in higher education: Preparing students for life and work in the 21st century. *Kindai Management Review*, 2020(8), 30-47.
- Rhodes, M. (1961). An analysis of creativity. *The Phi Delta Kappan*, 42(7), 305-310.
- Runco, M. A. (2007). A hierarchical framework for the study of creativity. *New Horizons in Education*, 55(3), 1-9. <https://doi.org/10.1016/j.tsc.2017.05.002>
- Sandri, O. J. (2013). Exploring the role and value of creativity in education for sustainability. *Environmental Education Research*, 19(6), 765-778. <https://doi.org/10.1080/13504622.2012.749978>
- Simonton, D. K. (1995). Exceptional personal influence: An integrative paradigm. *Creativity Research Journal*, 8(4), 371-376. https://doi.org/10.1207/s15326934crj0804_3
- Sipa, M. (2018). The factors determining the creativity of the human capital in the conditions of sustainable development. *European Journal of Sustainable Development*, 7(2), 1-1. <https://doi.org/10.14207/ejsd.2018.v7n2p1>
- Sloane, H. N., Endo, G. T., & Della-Piana, G. M. (1980). Creative behavior. *The Behavior Analyst*, 3(1), 11-21.
- Tollingerova, D., Goloushova, D., & Kantorkova, G. (1994). *Psychology of planning children's mental development*. Moscow: Rospedagenstvo Publ.
- UNESCO. (2014). *Aichi-Nagoya declaration on education for sustainable development*. Retrieved from https://sustainabledevelopment.un.org/content/documents/5859Aichi-Nagoya_Declaration_EN.pdf
- UNESCO. (2015). *The education 2030 framework for action*. Retrieved from https://uis.unesco.org/sites/default/files/documents/education-2030-incheon-framework-for-action-implementation-of-sdg4-2016-en_2.pdf
- UNESCO. (2020). *Education for sustainable development: A roadmap UNESCO publishing*. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000374802>
- UNESCO. (2023). *What you need to know about education for sustainable development*. Retrieved from <https://www.unesco.org/en/education-sustainable-development/need-know>
- Wang, Y. (2009). On cognitive foundations of creativity and the cognitive process of creation. *International Journal of Cognitive Informatics and Natural Intelligence*, 3(4), 1-18. <https://doi.org/10.4018/jcini.2009062301>